

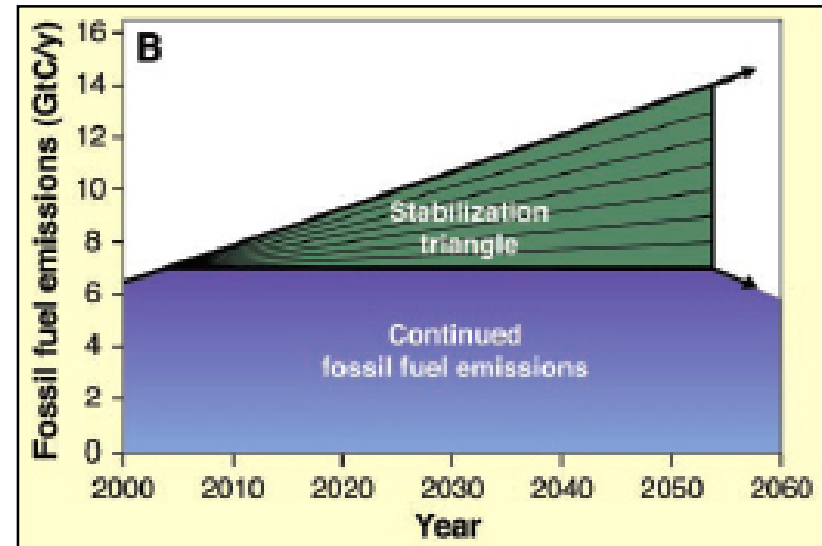
Storage of CO₂ for Climate Change Mitigation

**Larry R. Myer
Earth Sciences Division
Lawrence Berkeley National Laboratory
Berkeley, CA**

There Is No “Silver Bullet” for CO₂ Stabilization

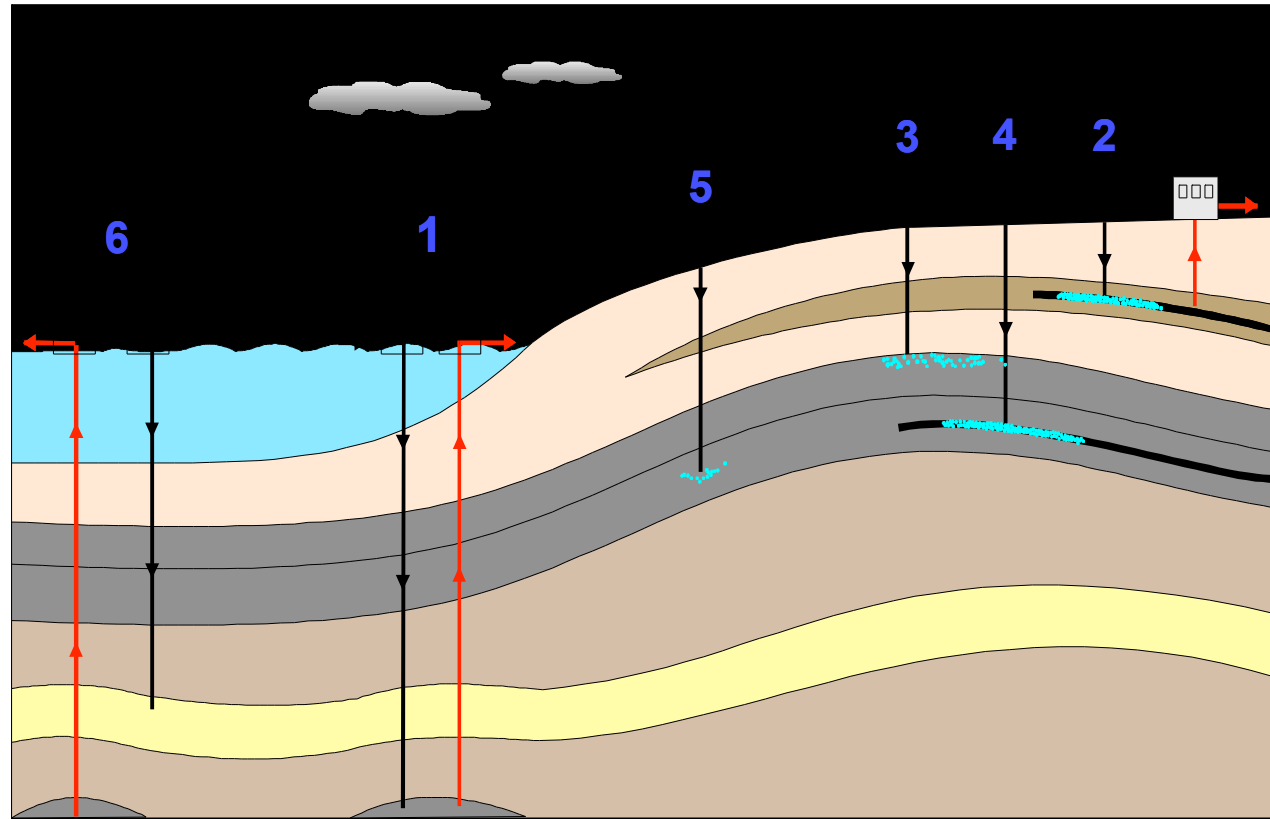


- ❖ Increase efficiency by 25% in buildings and appliances
- ❖ Add 100 times current U. S. ethanol production
- ❖ Increase fuel economy for 2 billion cars from 30 to 60 mpg
- ❖ Add 2000 GW-peak PV on 2×10^6 ha
- ❖ Decrease tropical deforestation to zero and establish 300 Mha of plantations
- ❖ Create 3500 “Sleipners” to store CO₂ captured from large point sources
- ❖ Add 700 GW nuclear power



Source: Pacala and Socolow, Science, 2004

Options for Geological Storage

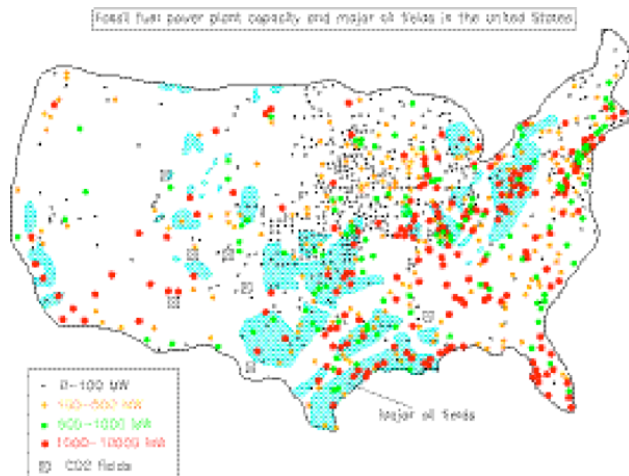


- ❖ 1. Enhanced oil and gas recovery; 2. Enhanced coal bed methane
- ❖ 3. Depleted oil and gas reservoirs; 4. Deep un-mineable coal seams
- ❖ 5. Voids and caverns; 6. Deep saline water saturated formations

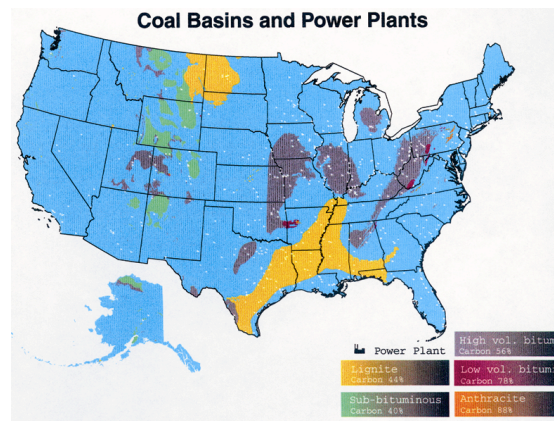
Potential Geologic Storage Formations are Broadly Distributed



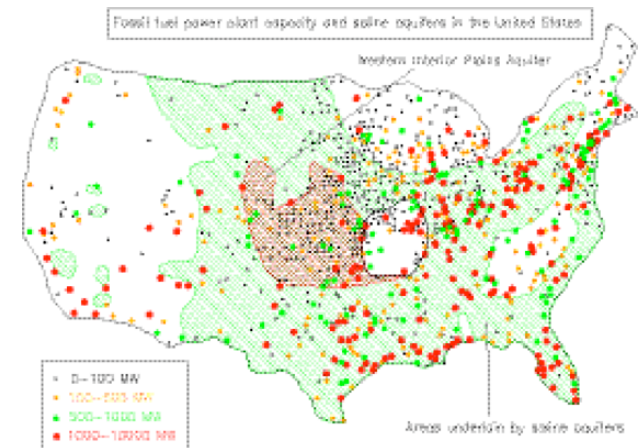
Depleted Oil & Gas Reservoirs



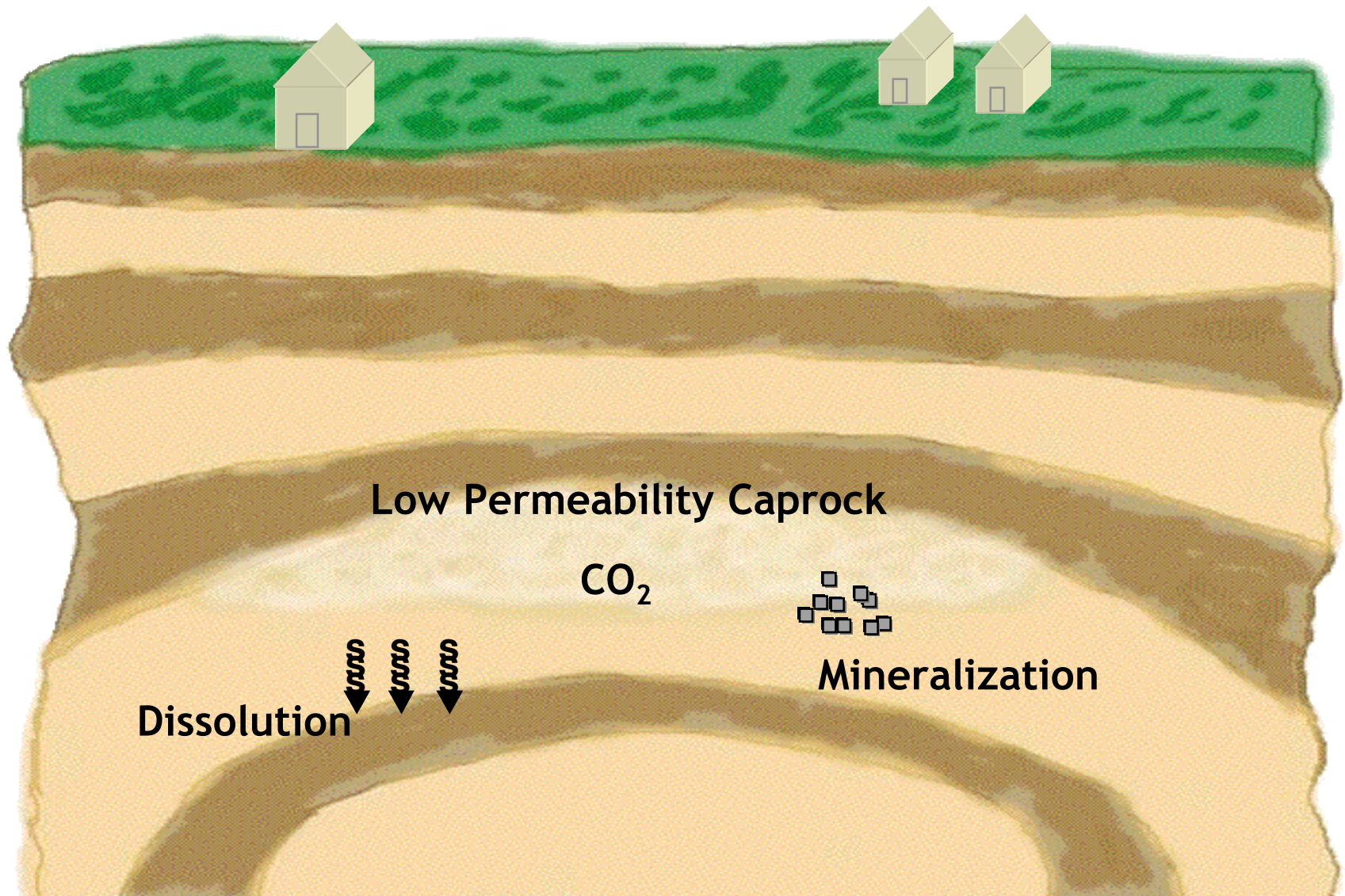
Unmineable Coal-Beds



Brine-Filled Formation



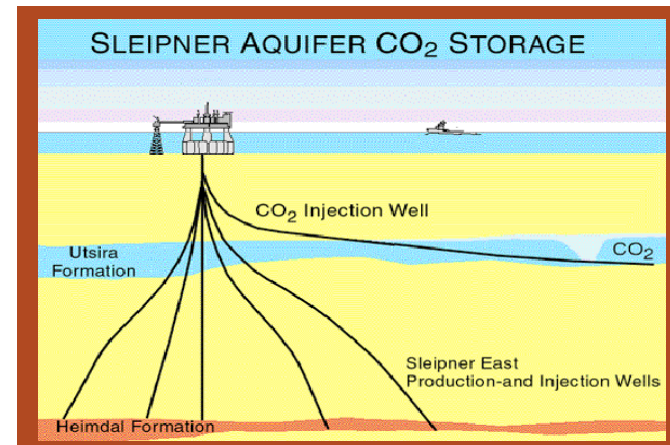
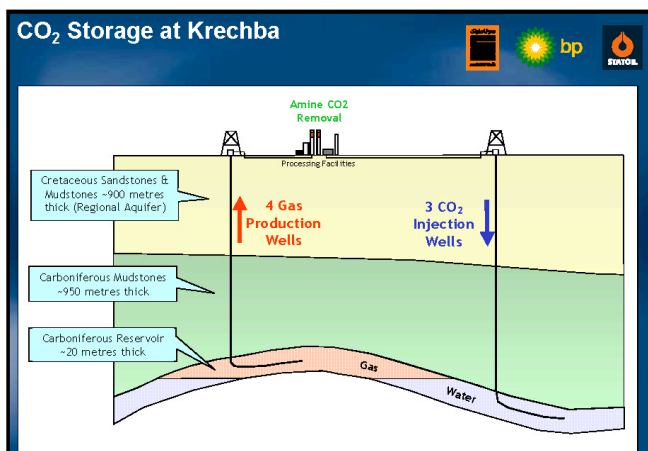
CO₂ Storage Mechanisms



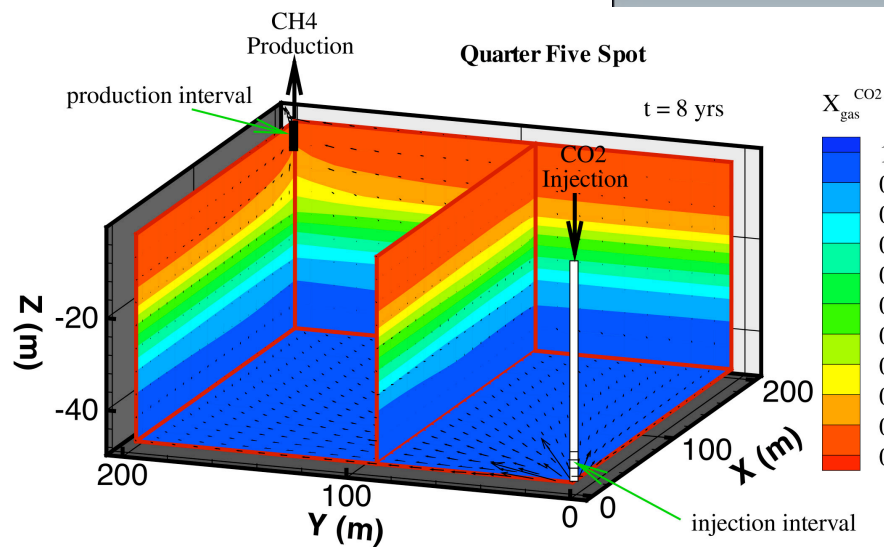
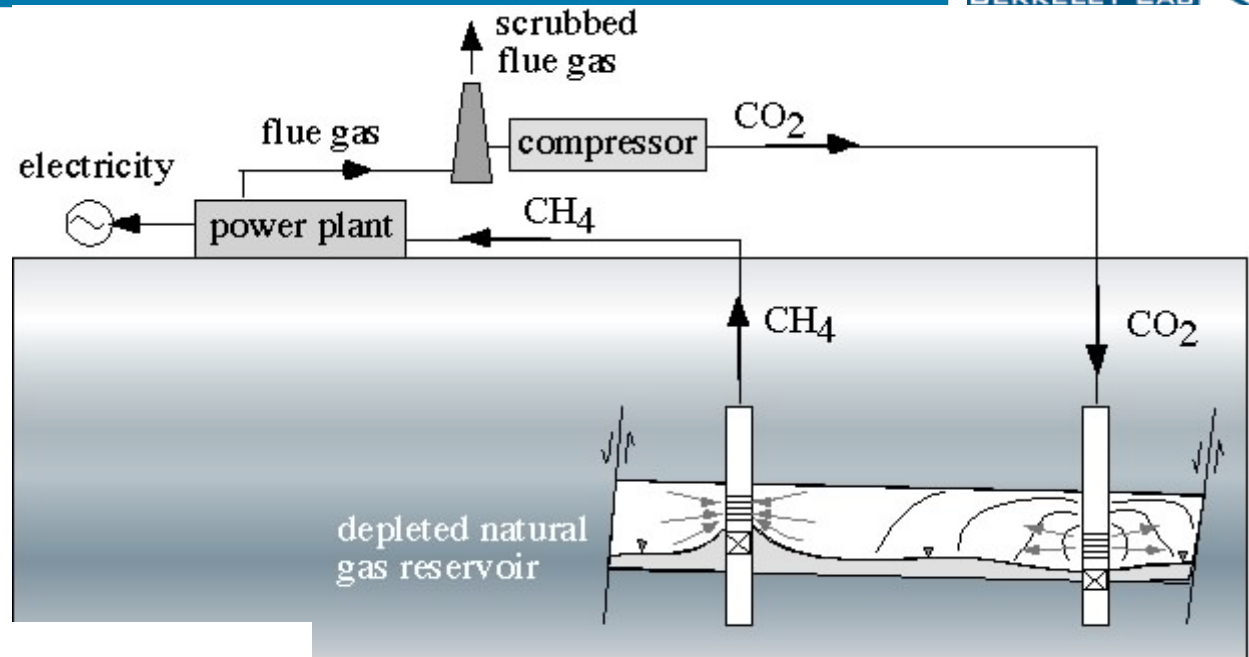
Geologic Storage Is Already Under Way



- ❖ Statoil injects 1×10^6 tons per year at Sleipner
- ❖ BP to inject 0.8×10^6 tons per year at In Salah



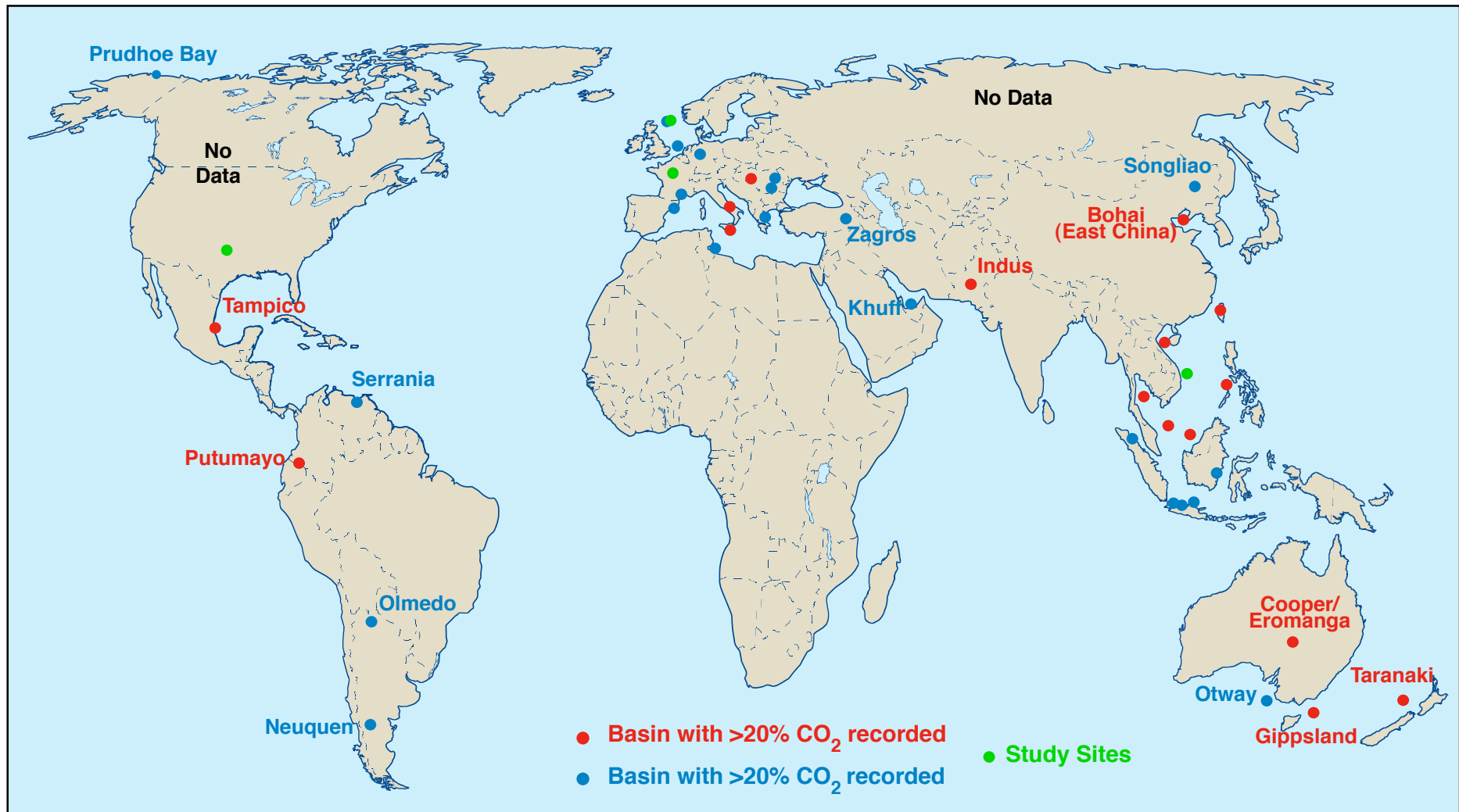
Enhanced Oil and Gas Recovery with CO₂ Storage Reduces costs



Will CO₂ Sequestration Create Ecological and Human Health Risks?



Global Occurrence of CO₂ in Petroleum Reservoirs

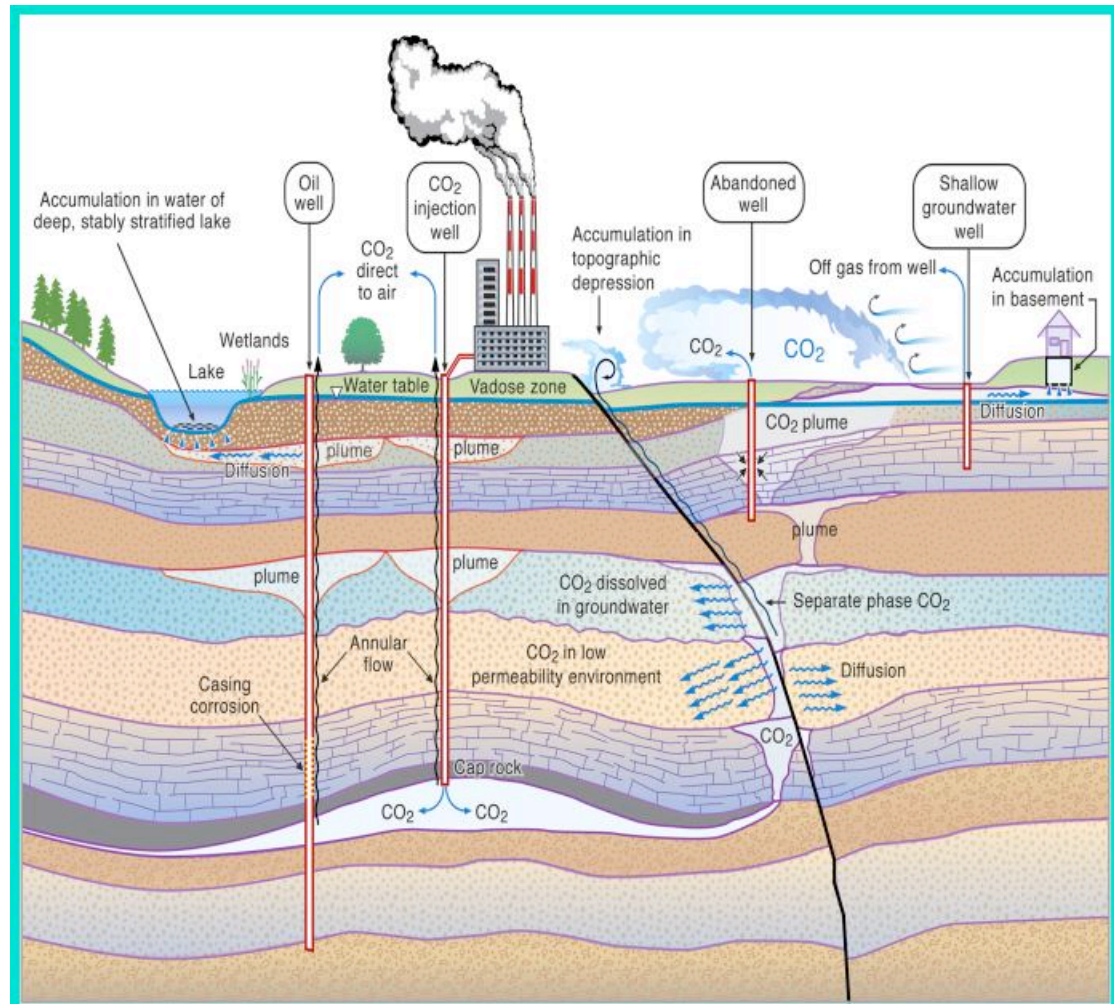


Source: BP

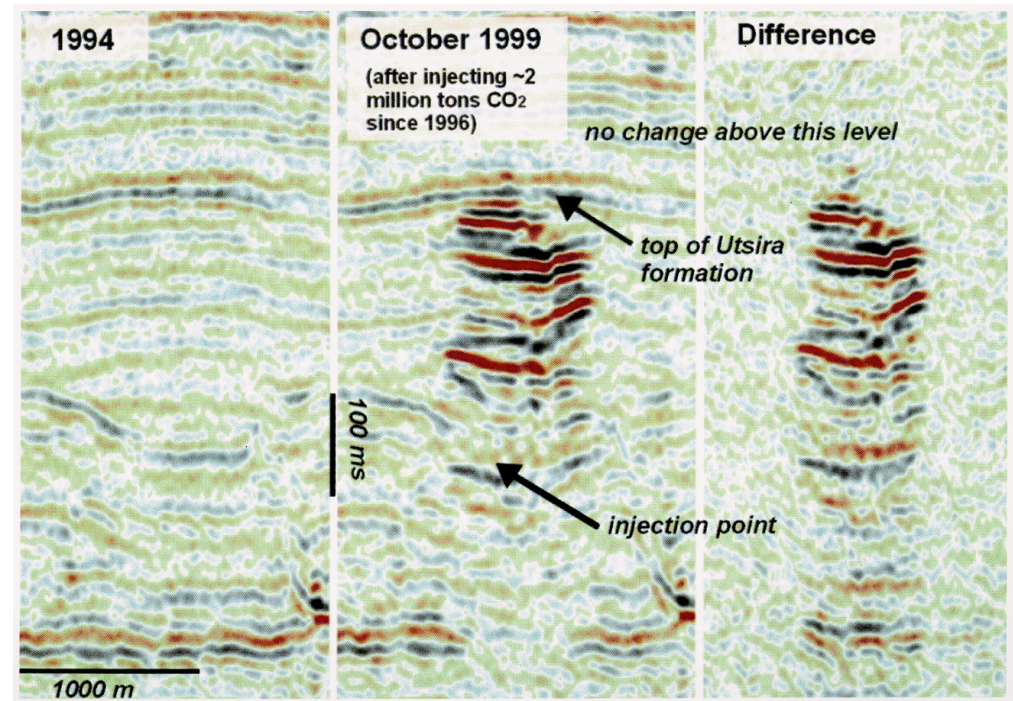
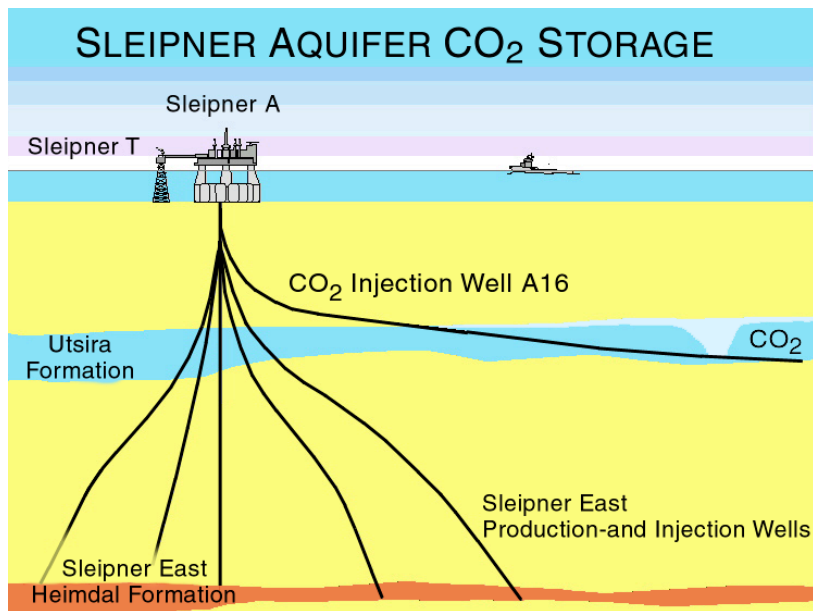
Assessment of HSE Risk is a Part of Regional Screening



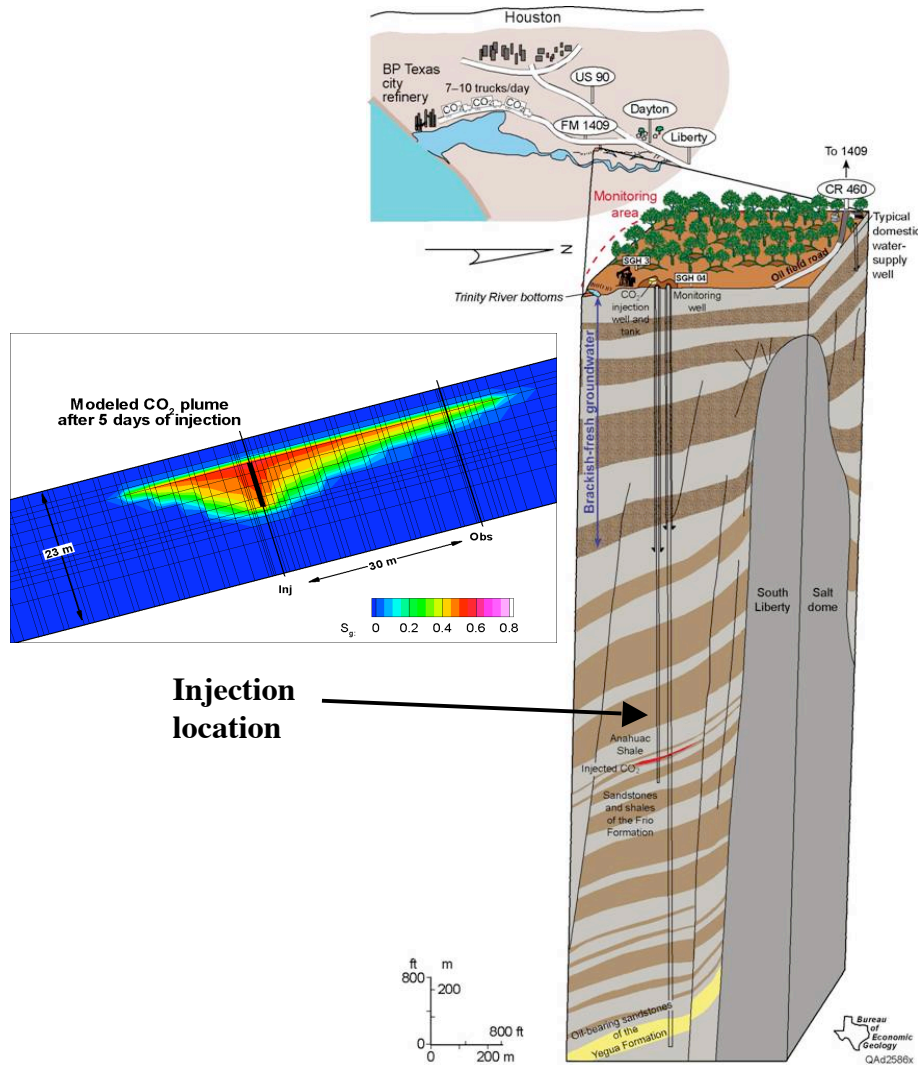
- ❖ Spreadsheet model for scoring health, safety, and environmental risks due to leakage
- ❖ Three primary controlling characteristics
 - Potential for primary containment
 - Potential for secondary entrapment
 - Dispersive capacity



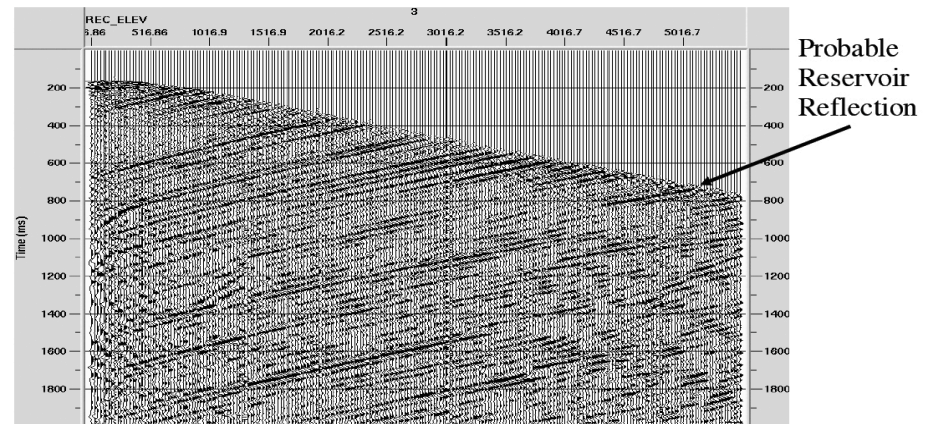
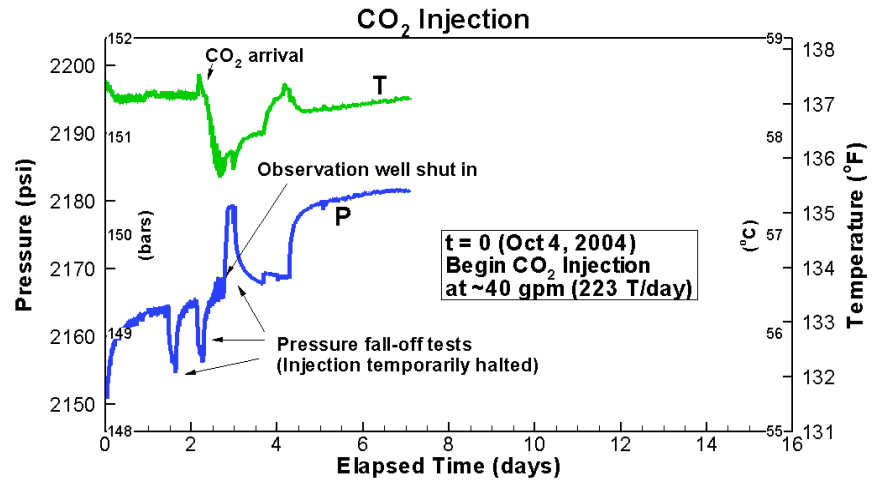
Monitoring Technology Base is Available in Oil and Gas Industry



Small Scale Pilots Provide Baseline Experience for Large Scale Tests



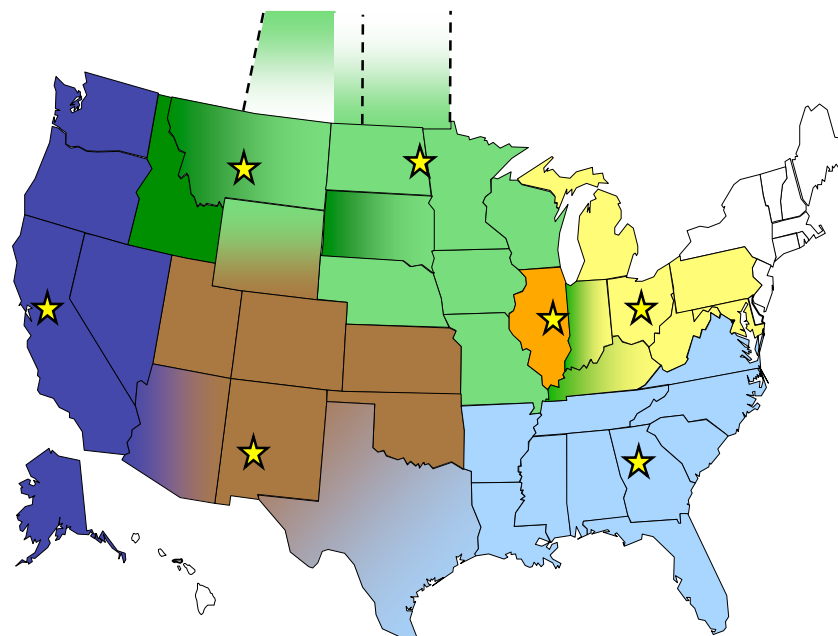
Injection location



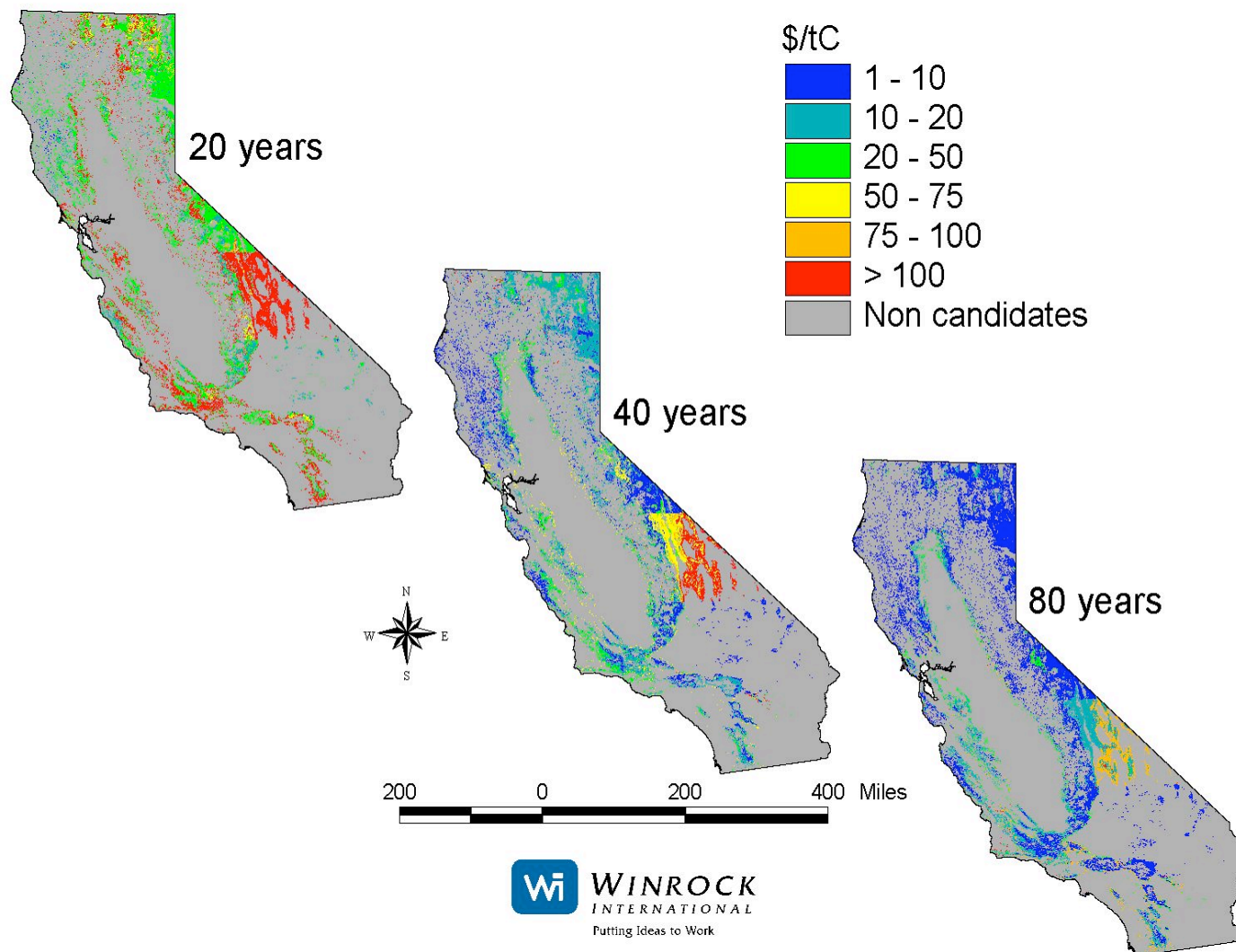
WESTCARB is One of Seven in DOE Program



- ❖ Partnership is evaluating terrestrial and geologic options for CO₂ sequestration in the region
- ❖ Sources and sinks are characterized, costs and risks are assessed, public outreach is addressed
- ❖ Partnership has broad stakeholder representation



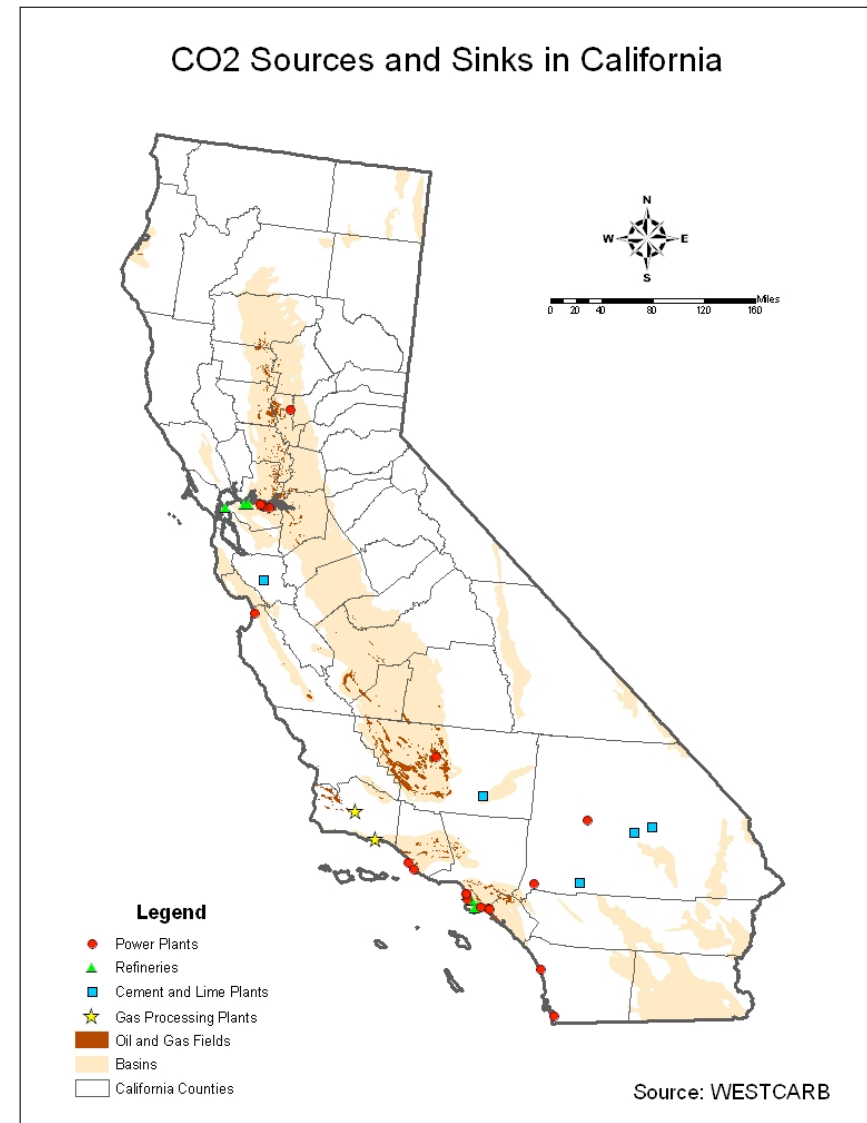
Reforestation Offers Large Terrestrial Storage Option for California



Geologic Formations Provide Greatest Potential Storage Capacity for California



- ❖ **CO₂ EOR is lowest cost near term option**
 - EOR reservoir capacity of 3.4Gt CO₂ – about 27 years of utility and industrial emissions (at current rate)
 - If retrofit power plants for capture, cost ~\$40/t CO₂
- ❖ **Current estimate of Calif. saline reservoir capacity: 150 – 850Gt CO₂**



Conclusions



- ❖ **CO₂ storage is one viable climate change mitigation approach**
- ❖ **CO₂ can be trapped in sediments by physical and chemical processes**
- ❖ **Using the CO₂ to enhance oil and gas production will offset costs**
- ❖ **Sites need to be screened for leakage risk**
- ❖ **Field testing is essential to build the experience needed for full scale deployment**
- ❖ **Regional assessments provide basis for deployment of CO₂ storage in U. S.**